

# **Long-Term Variable Milfoil Management and Control Plan for FOREST LAKE Winchester, New Hampshire Cheshire County**

Prepared by: New Hampshire Department of Environmental Services (DES),  
in consultation with the  
New Hampshire Fish and Game Department (F&G)  
Prepared January 2007  
Amended January 2008

## **PROBLEM STATEMENT**

Exotic aquatic plants pose a threat to the ecological, aesthetic, recreational, and economic values of lakes and ponds (Luken & Thieret, 1997, Halstead, 2000). According to the 2006 Section 305(b) and 303(d) Consolidated Assessment and Listing Methodology (CALM), “exotic macrophytes are non-native, fast growing aquatic plants, which can quickly dominate and choke out native aquatic plant growth in the surface water. Such infestations are in violation of Env-Ws 1703.19, which states that surface waters shall support and maintain a balanced, integrated and adaptive community of organisms having a species composition, diversity, and functional organization comparable to that of similar natural habitats of a region” (DES, 2006).

Though exotic aquatic plants can negatively impact an aquatic system, native aquatic plants are beneficial to the aquatic ecology of waterbodies. Diverse assemblages of native aquatic plants are a source of oxygen to the system, they provide stabilizing root systems to minimize erosion and turbidity, and they provide food and habitat for aquatic life.

Variable milfoil became established in Forest Lake, Winchester, New Hampshire in the late 1990s (Figure 1). It is currently found in dense patches of 75-80% cover in the Campground Inlet (Area 1) and the southern end of the lake (Area 2). Milfoil patches also exist in the lake outlet channel along the northern end, and sporadically along the shoreline. Figure 1 illustrates the distribution of milfoil in Forest Lake mapped on September 21, 2006. These areas are summarized below:

**Area 1-** This area is approximately 9 acres, and includes the entire arm of Campground Inlet. Milfoil is present both as small clumps and large patches throughout the channel, and the overall percent cover of the variable milfoil in this area is estimated at 80%. Water depths here are less than 5 feet and the bottom sediments are primarily composed of silt and organic matter, which is conducive to variable milfoil growth. There is a large privately owned campground on the adjacent shore that has between 20 and 25 docks and additional boats permanently moored throughout the summer season. The campground also provides a private boat launch used throughout the summer by campground patrons. A public bathing place located near this area (the swim beach is bounded by patches of milfoil growth). The inlet channel is approximately 50 yards from this swim beach. The public bathing beach is impacted by variable milfoil growth and drifting fragments.

**Area 2-** This area covers approximately 6.9 acres of the southern end of the lake. Variable milfoil plants here are mature and woody, and extend to the water's surface in 8-10 foot depths. In some areas milfoil exists in small clumps, but large milfoil patches dominate this area. The overall variable milfoil cover in this area is roughly 20%. Bottom sediments are mostly silty, containing a high organic fraction. The shoreline area is made up of mostly sand with lesser amounts of organic fractions. Water depths are 12 feet or less in this area.

**Points 42-44-** This area at the northern end of the lake has small patches of milfoil scattered along the outlet channel. The substrate here is a mix of rock, sand, and silt. This is the outlet area of the lake, so it is important to control milfoil in this area so that it doesn't spread downstream. The State of New Hampshire has purchased land on Route 10 at the outlet of the lake with the intent to build a public access site there.

In terms of the milfoil impacts to shorefront property owners, there are approximately 120 houses surrounding the Forest lake shoreline or that have lake access. Area 1 has no houses, and most of the northwestern shoreline of this cove is owned by the campground, with 200+ campsites. Area 2 has 25 houses along the shoreline. Many of these houses, particularly those in the southern end, abut areas of dense milfoil growth. Lake residents have expressed concern on the milfoil growth, citing access problems in front of their properties when they wish to use the lake for swimming or boating.

At this time, there are no data and no observed problems with the biological integrity of the aquatic community as a result of the variable milfoil infestation; however, the variable milfoil infestation is still somewhat localized. No biological integrity surveys have been conducted, however, as part of this plan preparation.

## **PURPOSE**

In September 2006, the Forest Lake Association and the Town of Winchester Conservation Commission requested matching funds from the Department of Environmental Services to conduct an exotic aquatic plant control project during the spring of 2007.

The purposes of this exotic aquatic plant management and control plan are:

1. To identify the waterbody's beneficial use areas, including essential aquatic habitat, designated conservation zones, swimming areas, boat access sites, and boating use areas;
2. To present the aquatic macrophyte distribution map, including both native and exotic species;
3. To identify short-term and long-term exotic aquatic plant control goals that protect and conserve the lake's beneficial uses;
4. To recommend exotic plant control actions that meet the goals outlined in this plan; and
5. To recommend monitoring strategies to determine the success of the control practices over time in meeting the goals.

This plan also summarizes the current physical, biological, ecological, and chemical components of Forest Lake and the social and ecological impacts of the milfoil infestation. The intent of this strategic plan is to eradicate variable milfoil from Forest Lake over time through the use of Integrated Pest Management Strategies (IPM). Appendix A details the strategies available for

waterbodies with exotic species, and provides more information on each of the activities that are recommended within this plan.

### **GOALS/OBJECTIVES OF MILFOIL CONTROL ACTIONS**

The aquatic plant management plan for Forest Lake outlines actions to eradicate variable milfoil (*Myriophyllum heterophyllum*, referred to as “variable milfoil” in this plan) while maintaining native plant communities whenever variable milfoil control actions are being implemented.

The goal for Forest Lake is the eventual eradication of milfoil from the system using an Integrated Pest Management Approach. To achieve this goal, we recommend the following:

- 1) To reduce the overall percent of milfoil bottom growth in Area 1 and 2 from 90% and 20% cover (respectively) in 2007 and 2008, with the use of 2,4-D, to less than 5% cover in each area to allow for smaller scale control actions to take place in future years.
- 2) To eradicate variable milfoil infestations located at Points 42-44 by hand-removal and benthic barrier placement.
- 3) To eradicate variable milfoil infestations throughout the Lake by 2012 by performing variable milfoil control actions on any exotic plants remaining after actions 1) and 2) above, using hand-removal, benthic barriers, and/or diver-assisted suction harvesting in August 2007, and annually thereafter if new stems or localized patches are present.
- 4) To maintain a Weed Watcher program for the lake, and a Lake Host Program if a public access site is created.

### **Town Support**

Winchester’s Park & Recreation Department maintains and owns a public beach on Forest Lake. The beach has a designated swim area, a lifeguard, and is open to the general public.

The Town of Winchester has a Conservation Commission to protect the Town’s natural resources and ensure the utilization of these resources is appropriate. Among its many activities is its commitment to Forest Lake, as shown by the following actions:

- ❑ Provide necessary funds to monitor water quality trends in Forest Lake
- ❑ Contribute milfoil control treatment funds for 2004 and 2007, including support for divers to hand-remove variable milfoil.
- ❑ Acquire donations to purchase waterfront property for public use, including fishing, swimming and boating.

### **Forest Lake Improvement Association Support**

Forest Lake has an active lake association. The Forest Lake Improvement Association (FLIA) has been in existence for over 75 years.

When milfoil was first treated with an herbicide in Forest Lake, a backwater area on the western shore was identified as a possible source for milfoil introduction to the lake. DES recommended a fragment barrier be placed across a ten foot opening to the back water. The FLIA complied and has monitored the situation over the years. The barrier had to be replaced twice after winter ice-outs but remains in place today.

One major association activity is the operation of the Forest Lake dam located on Route 10. The dam is located on private land, where the FLIA originally funded dam construction in the 1940s. Member funding and DES Dam Bureau support has facilitated annual maintenance.

Some additional activities of note include:

- ❑ Member of NH Lakes Association
- ❑ Trained members of the State's Weed Watchers Program
- ❑ Trained VLAP members for water monitoring activities
- ❑ Supported and/or conducted annual water testing on Forest Lake for over 20 years.
- ❑ Distributes 'Welcome Packages' to new Forest Lake property owners which include information on water safety, environmental do's & don'ts and lake health and exotic species
- ❑ Obtained legal support to have the FLIA represented in a zoning case to prohibit permitting of a large gravel pit in close proximity to Forest Lake. Permitting of the gravel pit may have caused additional damage to the health of the lake if not managed properly.

The lake association is also committed to performing follow-up monitoring for milfoil re-growth, and working with DES to coordinate hand-removal and benthic barrier placement for further variable milfoil control.

## **WATERBODY CHARACTERISTICS**

Table 1 summarizes basic physical and biological characteristics of Forest Lake.

<b>General Lake Information</b>	
Lake area (acres)	87.2
Watershed area (acres)	4480.0
Shoreline Uses (residential, forested, agriculture)	Residential, forested
Max Depth (ft)	32
Mean Depth (ft)	16
Trophic Status	Mesotrophic
Flushing Rate (yr <sup>-1</sup> )	5.0
Color (CPU) in Epilimnion	24
pH	6.85 Epilimnion/6.21 Hypolimnion
Clarity (ft)	12.5
Natural waterbody/Raised by Damming/Other	Raised by damming
<b>Plant Community Information Relative to Management</b>	
Invasive Plants (Latin name)	<i>Myriophyllum heterophyllum</i>
Infested Area (acres)	Approximately 16 acres
Distribution (ringing lake, patchy growth, etc)	Dense patches in inlet channel and southern end of lake. Small patches at northern end of

	lake and along shoreline segments.
Sediment type in infested area (sand/silt/organic/rock)	Silty/organic/rock
Rare, Threatened, or Endangered Species in Waterbody (based on NH Natural Heritage Bureau database)	River Bank Quillwort ( <i>Isoetes riparia</i> )
Area of Littoral Zone (acres)	29
Area of Profundal Zone (acres)	58
Area of Macrophyte Coverage (native and exotic) in Littoral Zone (acres)	22
% of Littoral Zone with Macrophyte Cover	75%
% of Macrophyte cover comprised of invasives	72%
% of Littoral Zone with Milfoil Cover	55%

An aquatic vegetation map and associated key derived from a summer 2006 DES Lake Assessment is shown in Figure 2. A bathymetric map is shown in Figure 3.

### **BENEFICIAL (DESIGNATED) USES**

In New Hampshire, beneficial (designated) uses of our waterbodies are categorized into five general categories: Aquatic Life, Fish Consumption, Recreation, Drinking Water Supply, and Wildlife (CALM).

Of these, Aquatic Life and Recreation are the ones affected by the presence of variable milfoil.

### **AQUATIC LIFE**

The goal for aquatic life support is to provide suitable chemical and physical conditions for supporting a balanced, integrated and adaptive community of aquatic organisms having a species composition, diversity, and functional organization comparable to that of similar natural habitats of the region.

### **FISHERIES AND WILDLIFE**

Forest Lake in Winchester is managed by NH Fish and Game as a two-tiered fishery, meaning that it is managed for both warm and cold water species. The coldwater fishery is comprised of stocked brown trout and rainbow trout (stocking was discontinued from 2004 to the present due to the loss of the public boat ramp). This waterbody was electro-fished on August 6, 2002. Largemouth bass is the primary gamefish present. Largemouth bass growth was categorized as fast when compared to fish from other New Hampshire waterbodies sampled during 1997-2005.

Other fish collected in 2002 include yellow perch, pumpkinseed, eastern chain pickerel, common shiner, common white sucker, golden shiner and yellow bullhead.

This waterbody contains a popular and stable bass fishery. The campground attracts many in and out of state anglers.

Figure 4 illustrates the common fishing areas on Forest Lake, as presented by members of the lake association that track activity on the lake. Some of the areas indicated as prime fishing habitat by local fishing enthusiasts do fall within zones that are heavily impacted by variable milfoil growth.

## **RECREATION USES AND ACCESS POINTS**

Forest Lake is used for recreational activities including boating, fishing, swimming, and water skiing by both lake and town residents and campground visitors.

There are generally 25-30 lake-resident owned powerboats on the lake each year, and numerous canoes, kayaks, and row boats. There are also numerous floating docks and swim platforms around the lake as well. There is no designated public access for boats. Prior public boat access was through private property, but access was suspended in 2004. Some access may be achieved through the private campground on the lake (on average there are 5 boats per week that access Forest Lake from the campground). The State of NH has recently purchased land on Route 10 at the end of the North Channel on Forest Lake with the intent to build a public boat launch. The current milfoil infestation at the proposed public launch will facilitate the transport of milfoil from Forest Lake to other in-state or out-of-state lakes.

Figure 5 illustrates the public access points on Forest Lake. The Campground Beach is most impacted by growths of variable milfoil, as the Campground Inlet has regular patches and floating fragments generated by boating activity in the area, and auto-fragmentation of the variable milfoil. The Town Beach sees secondary impacts, as the variable milfoil fragments float over to the Town Beach and accumulate in the swim area.

Two public (also called “designated”) beaches exist on Forest Lake. A designated beach is described in the CALM as an area on a waterbody that is operated for bathing, swimming, or other primary water contact by any municipality, governmental subdivision, public or private corporation, partnership, association, or educational institution, open to the public, members, guests, or students whether on a fee or free basis. Env-Wq 1102.14 further defines a designated beach as *“a public bathing place that comprises an area on a water body and associated buildings and equipment, intended or used for bathing, swimming, or other primary water contact purposes. The term includes, but is not limited to, beaches or other swimming areas at hotels, motels, health facilities, water parks, condominium complexes, apartment complexes, youth recreation camps, public parks, and recreational campgrounds or camping parks as defined in RSA 216-I:1, VII. The term does not include any area on a water body which serves 3 or fewer living units and which is used only by the residents of the living units and their guests.*

A town beach is located on the north end of the lake. Roughly 20-30 people use the town beach during summer weekends. The campground beach, which is located west of the town beach on the same northern shoreline, is used more frequently, with 50 or more people participating in weekend recreational use. No data exist for weekday use at either beach.

Figure 6 shows the locations commonly used for swimming, and the locations of swim platforms on Forest Lake. The tan colored polygons shows locations where people generally use their waterfront areas and has private beach areas for swimming, and the red points show locations of swim platforms, further indicating use for swimming (out to the platforms). Many of these areas lie in the green shaded zones indicating variable milfoil coverage. In these areas, lake residents have expressed concerns about access for swimming, and safety of swimming in dense variable milfoil beds.

Figure 7 shows an approximation of the boating lanes on the lake. Pleasure boating by most watercraft takes place in the deeper portions of Forest Lake, as indicated by the boat paths in this figure. The exception to this is the Campground Inlet where there are many boats that make ingress and egress to this infested area. Also, canoes and kayaks generally use the shallows, where the variable milfoil is most common. Boat engines, propellers, and paddles can further promote fragmentation of the variable milfoil in the shallows.

### **MACROPHYTE EVALUATION**

The littoral zone is defined as the nearshore areas of a waterbody where sunlight penetrates to the bottom sediments. The littoral zone is typically the zone of rooted macrophyte growth in a waterbody. The littoral zone of Forest Lake (considered to be from the shoreline to a depth of 15 feet) is characterized by a mix of native and non-native (variable milfoil) plant growth (Figure 2). Native species include a mix of floating plants (yellow and white water-lilies, water shield), emergent plants (grasses, rushes, pickerelweed), and submergent plants (pondweed, waterweed, bladderwort). Native plant communities are comprised of a mix of various species and are distributed around the entire littoral zone of the lake.

There is a record of a state endangered plant species, the Riverbank Quillwort (*Isoetes riparia*), located near the public beach on the lake. The record was reported in 1966. The plant was not observed during the plant mapping activities in 2006.

## **HISTORICAL CONTROL ACTIVITIES ON FOREST LAKE:**

<b>Contractor</b>	<b>Management Type</b>	<b>Chemical Application/ Treatment Date</b>	<b>Treatment Area (acres)</b>	<b>Effectiveness</b>
DES and lake residents	Fragment barrier	Summer 2000	n/a	Effective in trapping fragments within small pond adjacent to shoreline of Forest Lake
Aquatic Control Technology	2,4-D herbicide	Completion date: July 31 <sup>st</sup> 1998	9.55	Good control. Reduced milfoil biomass to scattered stems.
Lycott Environmental	Diquat herbicide	June 9 <sup>th</sup> 2004	35	Contained existing patches of milfoil.
Aquatic Control Technology	2,4-D herbicide	June 2007	16	Good control. Reduced milfoil from 16 acres to four acres.

## **MILFOIL MANAGEMENT OPTIONS**

The control practices used should be as specific to milfoil as feasible. No control of native aquatic plants is intended.

Exotic aquatic plant management relies on a combination of proven methods that control exotic plant infestations, including physical control, chemical control, biological controls (where they exist), and habitat manipulation. Integrated Pest Management Strategies (IPM) are typically implemented using Best Management Practices (BMPs) based on site-specific conditions so as to maximize the long-term effectiveness of control strategies. Descriptions for the control activities are closely modeled after those prescribed by the Aquatic Ecosystem Restoration Foundation (AERF) (2004). This publication can be found online at [http://www.aquatics.org/aquatic\\_bmp.pdf](http://www.aquatics.org/aquatic_bmp.pdf).

Criteria for the selection of control techniques are presented in Appendix A. Appendix B includes a summary of the exotic aquatic plant control practices used by the State of New Hampshire. DES has evaluated the feasibility of potential control practices on Forest Lake. The following table summarizes DES' control strategy recommendations for Forest Lake.



## FEASIBILITY EVALUATION FOR CONTROL ALTERNATIVES

Control Method	Use on Forest Lake
Restricted Use Areas (RUA)	No RUAs are needed or recommended on Forest Lake at this time.
Fragment Barrier	A fragment barrier is recommended to be installed in 2007 and every summer thereafter as long as variable milfoil is present within Site 1. The net should be installed at the mouth of the Campground Inlet (lakeward side of Area 1) where it enters Forest Lake. The fragment barrier can be installed in two pieces, one extending off from each shoreline, and staggered, to allow for ease of ingress and egress through the channel by boaters. [The fragment barrier will only extend one foot down into the water column from the surface, and extend about 4 inches above the surface of the water to trap fragments. The netting should have mesh size no larger than 1-inch to prevent fragments from breaching the barrier. Because of this configuration, fish and wildlife migration into and out of Campground Inlet will not be restricted.]
Hand-pulling	<p>Individual stems or small patches of milfoil should be pulled in 2007 in the northern end of the lake in the outlet channel. The patches are small enough to successfully manage them with this practice, as they are generally less than 2'x2' in size.</p> <p>Lake residents should follow up the herbicide application with hand-pulling of re-growth, if that re-growth is small and scattered.</p>
Mechanical Harvesting/Removal	Mechanical harvesting is not recommended due to the threat of spreading milfoil to uninfested areas of the lake through the generation of fragments.
Benthic Barriers	Install small benthic barriers in late 2007 and subsequent years as needed if small patches of milfoil re-grow and can adequately be contained by benthic barriers. Installing benthic barriers throughout the lake is not recommended.
Herbicides	The herbicide 2,4-D is recommended for use in 2007 to greatly reduce biomass and areal extent of milfoil in the Campground Inlet and in the southern end of the lake (Area 1 and Area 2). The goal is reduction to the point where non-herbicide controls are feasible. A second herbicide treatment in 2008 is recommend as a follow-up, as needed, particularly in the southern end of the lake where the milfoil is more mature and the root crowns are likely more established.
Dredge	Not recommended due to nature of the milfoil distribution, and the fact that history has shown that variable milfoil quickly colonizes dredged areas.
Biological Control	There are no biological controls for milfoil at this time in New Hampshire.
No Control	Forest Lake has been battling exotic milfoil growths for some time now. DES has observed that herbicide application minimizes and contains the infestations. DES does not recommend a 'no control' option, as we believe that 100% of the littoral zone of Forest Lake is susceptible to milfoil infestation based on the water depth and the substrate type.

## **EXOTIC AQUATIC PLANT CONTROL PLAN**

An evaluation of the size, location, and type of variable milfoil infestation, as well as the waterbody uses was conducted by DES during September 21, 2006, and again on September 26, 2007. Based on the evaluation, the following control actions are recommended:

<b>Year</b>	<b>Treatment Type</b>	<b>Responsible Party</b>	<b>Schedule</b>
2007	1. 2,4-D treatment of Campground Inlet and Southern End of Forest Lake (Area 1 & 2, Figure 1)	Aquatic Control Technology, Inc.	May/June
	2. Install fragment barrier at Campground Inlet	NH DES and lake residents	June
	3. Train local divers for hand-removal techniques	NH DES and lake residents	June/July
	4. Hand-removal of variable milfoil in outlet channel at northern end of lake	NH DES and lake residents	June/July
	5. End of season monitoring and re-mapping of infestation, including estimate of variable milfoil percent cover	NH DES	September
	6. Perform Weed Watcher activities	Lake residents	Monthly during summer months
2008	1. 2,4-D treatment of Campground Inlet and Southern End of Forest Lake as a follow-up to 2007 treatment, based on map provided in Figure 1-a.	Aquatic Control Technology, Inc.	May/June
	2. Monitor re-growth and re-map infestation, including estimate of variable milfoil percent cover.	NH DES	July
	3. Continue with hand-removal	Lake residents	June-August
	4. Install benthic barrier and Campground Inlet fragment barrier as may be appropriate.	Lake residents and NH DES	June-August as needed
	5. Perform Weed Watcher Activities	Lake residents	Monthly during summer months
2009	1. Evaluate success of 2008 herbicide activity and follow-up activities in eradication	NH DES	August
	2. Hand-removal and benthic barrier as needed, and install Campground Inlet fragment barrier as appropriate	Lake residents	June -August
	3. Perform Weed Watcher activities	Lake residents	Monthly during summer months
2010	1. Continue with monitoring and hand removal, and using benthic barriers as needed	Lake residents	June-August

Year	Treatment Type	Responsible Party	Schedule
	2. Perform Weed Watcher activities	Lake residents	Monthly during summer months
	3. Monitor re-growth and re-map infestation, including estimate of variable milfoil percent cover	NH DES	July
2011	2. Continue with hand-removal	Lake residents	June-August
	3. Install benthic barrier and Campground Inlet fragment barrier as may be appropriate	Lake residents	June-August
	4. Perform Weed Watcher activities	Lake residents	Monthly during summer months
2012	Update and revise Long-Term Variable Milfoil Control Plan	NH DES, F&G, and interested parties	Spring 2012

The herbicide application will be targeted to the specific areas of milfoil growth shown in Figure 1 in 2007, and Figure 1-a in 2008. Plant assemblages that are strictly comprised of native plant species will not be subject to control practices. Only areas with milfoil growth will be targeted for control activities. Approximately 18% of the lake is slated for herbicide treatment in 2007, based on the locations of variable milfoil growth mapped in 2006. This leaves the balance of the lake and associated native plant communities untouched. A total of 5% of the lake is slated for herbicide treatment in 2008.

### **CONSIDERATIONS FOR SELECTED MANAGEMENT PRACTICE**

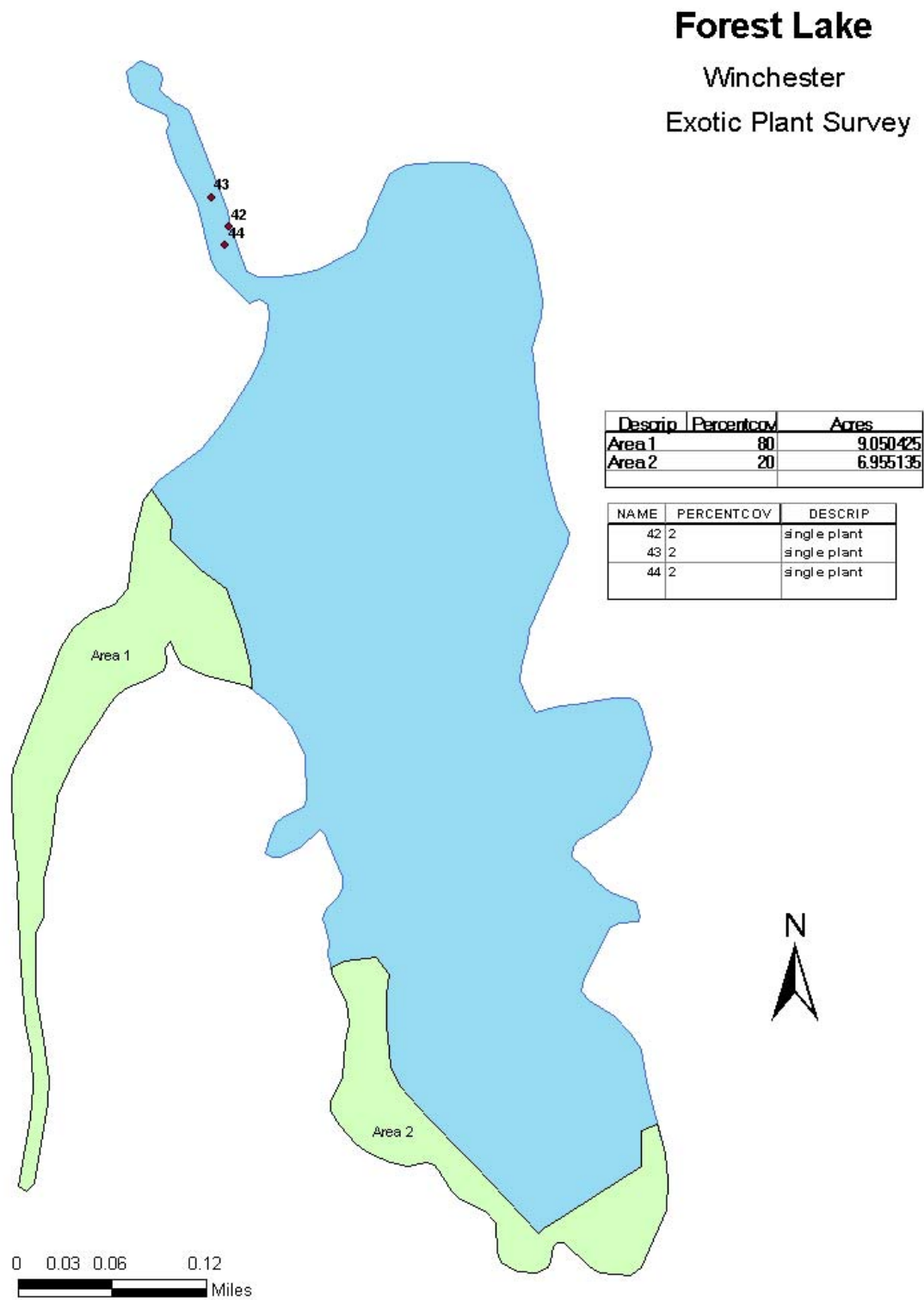
- Approximately 16 acres of the waterbody were targeted by the herbicide treatment (approximately 18% of the surface area) in 2007. A follow-up treatment of approximately 4 acres is recommended for 2008 to further control patches of milfoil growth in the lake. Following the treatment in 2008, the variable milfoil will likely be at a level that can easily be management my non-chemical controls for several years.
- The Department of Agriculture will impose standard short-term use restrictions for specified days depending on the waterbody uses (irrigation, contact, etc) and the herbicide label. The shoreline will be posted and public notice will be made.
- By recommending follow-up management practices for at least 5 years after the herbicide application, we will employ an integrated plant management approach such as benthic barrier placement and hand-pulling re-growth, so that variable milfoil re-growth or population expansion can be slowed. The ultimate goal is to eradicate milfoil from Forest Lake.
- The Fish and Game Department indicated the entire area of Forest Lake is valuable and important habitat for fish and aquatic wildlife. Use of herbicides will be restricted to only 16

acres (18% of the surface area) of Forest Lake in Area 1 and Area 2. In 2008, this footprint is even smaller, at only 5% of the lake surface area.

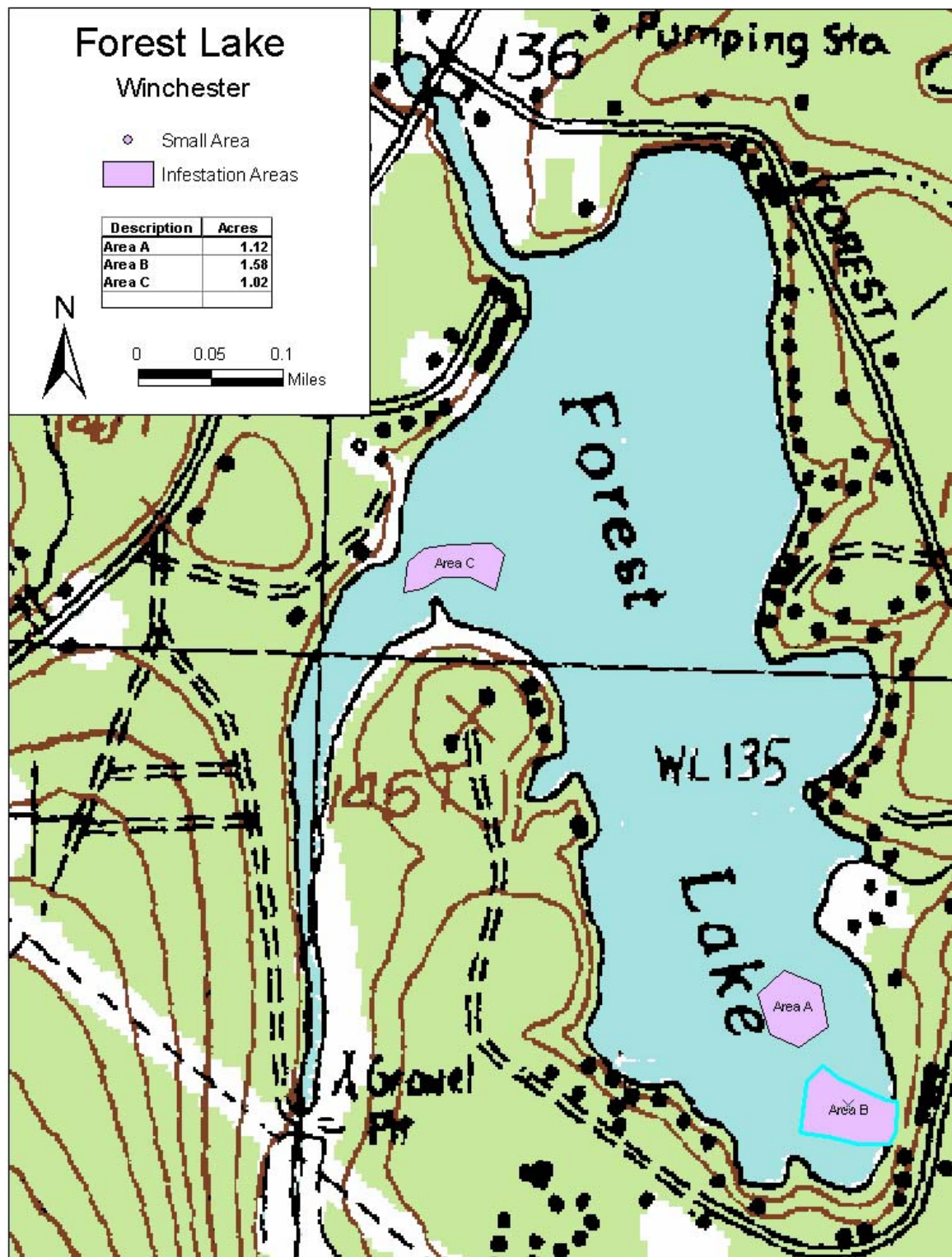
- Based on the types of native plants that are mixed in with the stands of milfoil (Figure 2) where herbicide application is recommended (primarily lily-like plants that include genera such as *Nuphar*, *Brasenia*, and *Nymphaea*), there are no significant impacts to native plant communities that are expected because these plants are not killed by 2, 4-D at the dosage that kills variable milfoil. Other species, such as *Utricularia*, *Elodea*, and *Potamogeton*, are not expected to be impacted.

## **FIGURES**

**Figure 1- Map of Milfoil Infestation**



**Figure 1a- Map of Milfoil Infestation for 2008 Treatment**



Long-term Variable Milfoil Management Plan for Forest Lake, Winchester





<b>Symbol</b>	<b>Common Name</b>	<b>Latin Name</b>
B	Watershield	<i>Brasenia schreberi</i>
N	White water-lily	<i>Nymphaea</i>
Y	Yellow water-lily	<i>Nuphar</i>
U	Bladderwort	<i>Utricularia</i>
X	Sterile thread-like leaves	<i>Eleocharis spp., likely</i>
F	Floating heart	<i>Nymphoides cordatum</i>
W	Pondweed sp.	<i>Potamogeton sp.</i>
C	Sedge	<i>Carex sp.</i>
E	Pipewort	<i>Eriocaulon</i>
S	Bur-reed	<i>Sparganium</i>
O	Buttonbush	<i>Cephalanthus occidentalis</i>
T	Cattail	<i>Typha</i>
R	Coontail	<i>Ceratophyllum</i>
<b>M</b>	<b>Variable milfoil</b>	<b><i>Myriophyllum heterophyllum</i></b>

Figure 3- Bathymetric Map of Forest Lake, Winchester

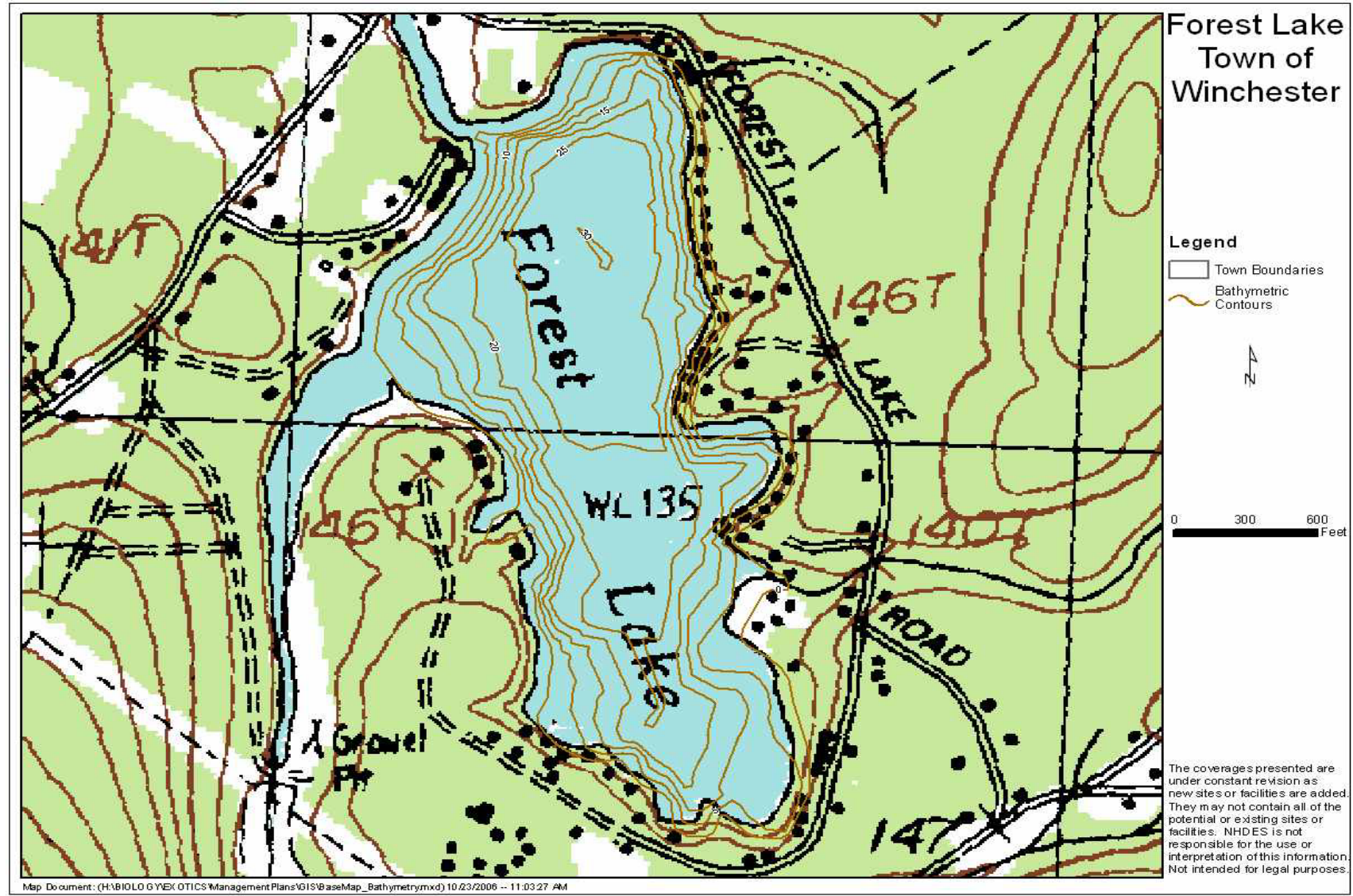
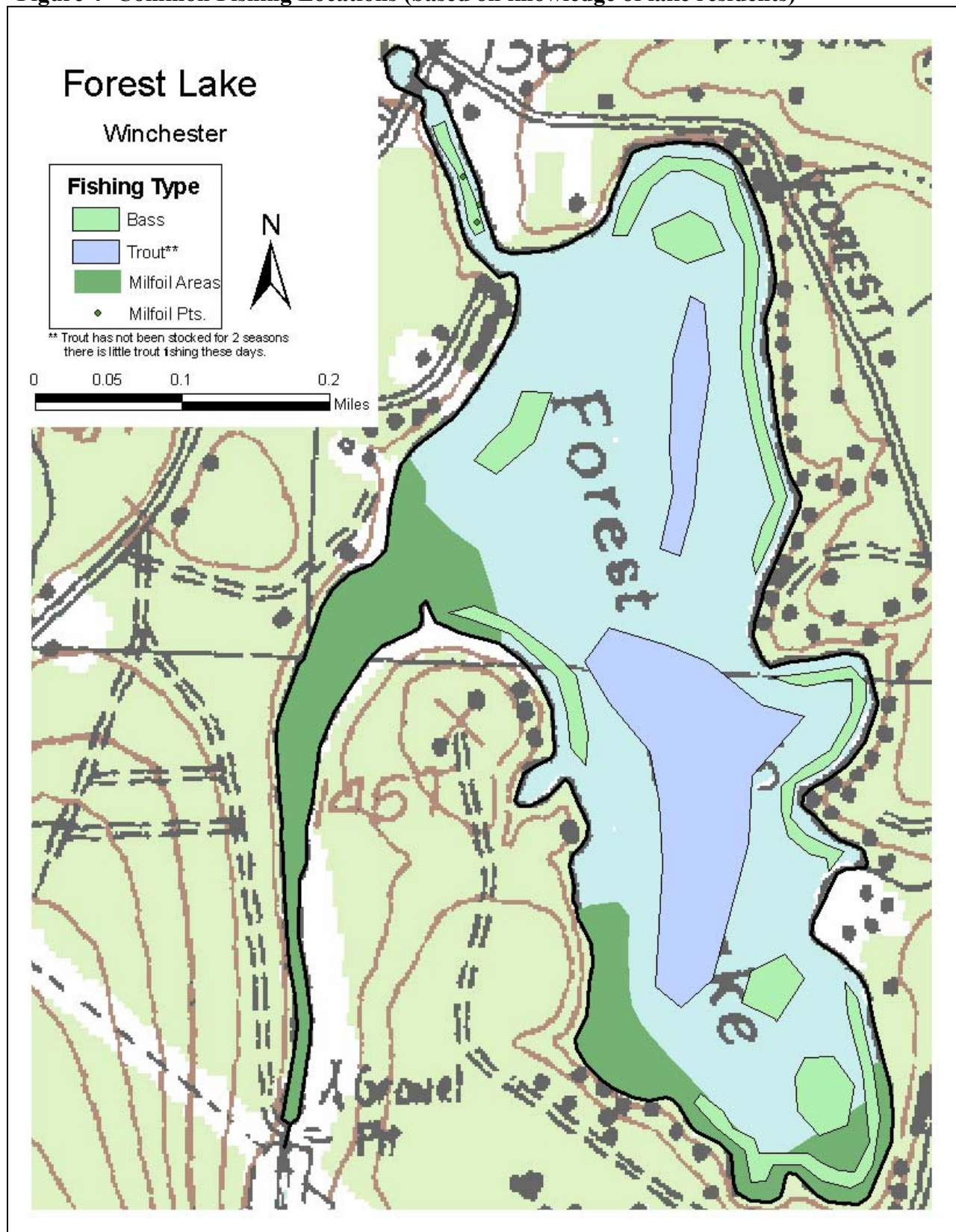


Figure 4- Common Fishing Locations (based on knowledge of lake residents)





**Forest Lake**  
Winchester

**Access Type**

- Public (Blue)
- Private (Red)
- Proposed (Blue with diagonal lines)
- Milfoil Areas (Green)

0 0.05 0.1 0.2 Miles

N

Proposed Boat Launch

Town Beach

Campgrd. Bch/Launch

Town Canoe/Picnic

Forest Lake

WL 135

Gravel Pit

Figure 6- Swim Areas

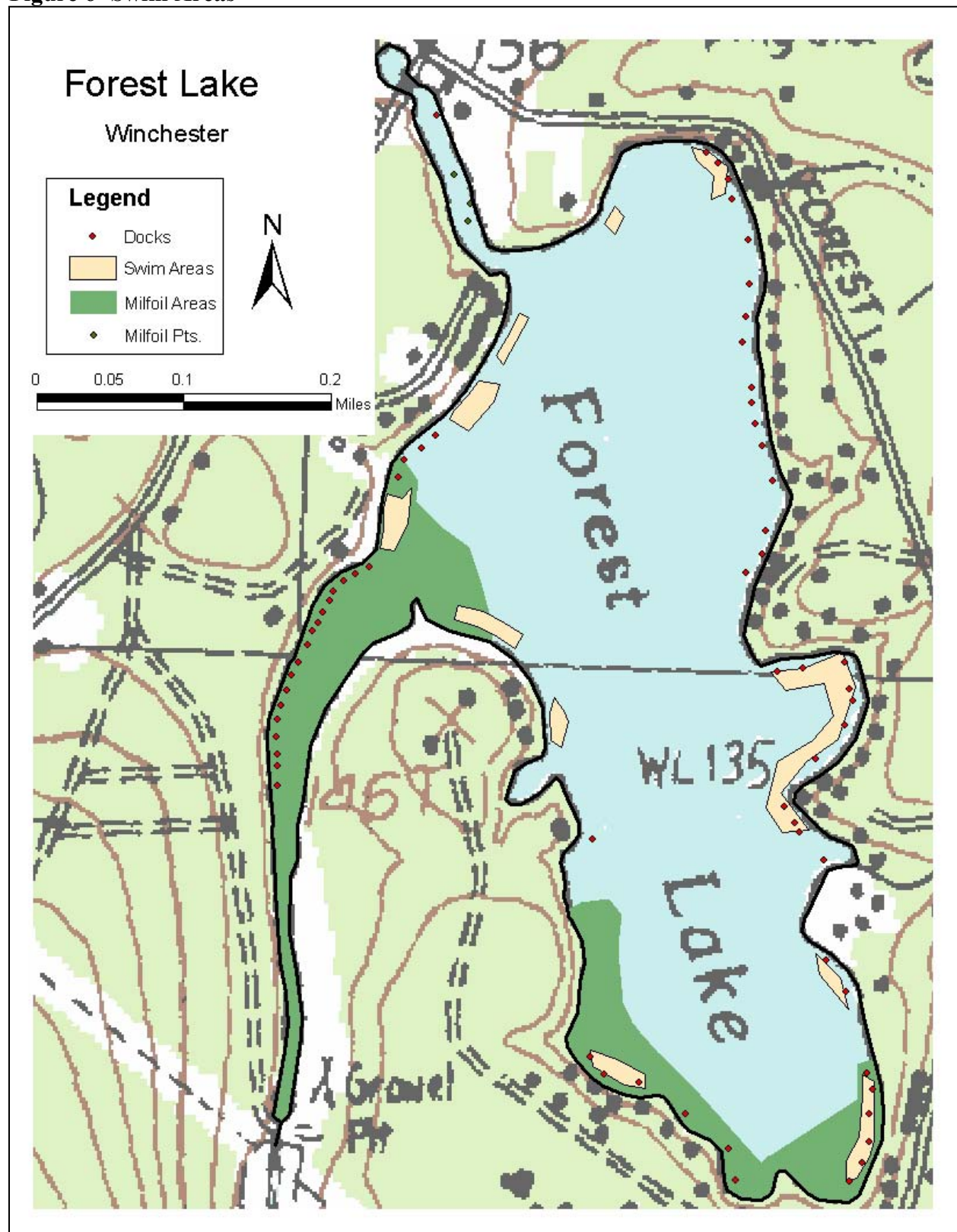
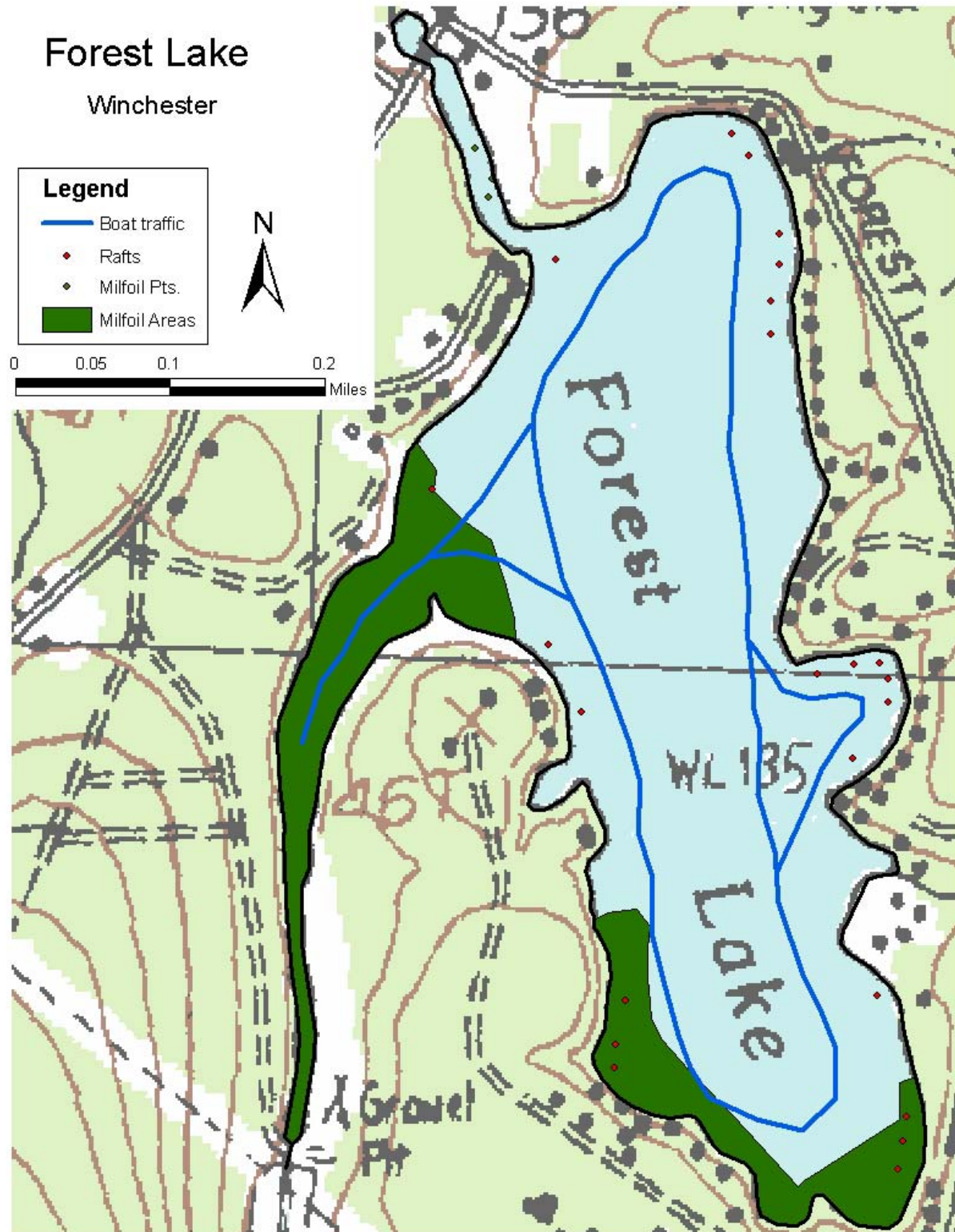




Figure 7- Common Boating Lanes and Swim Rafts



## **APPENDIX A**

### **CRITERIA TO EVALUATE THE SELECTION OF AQUATIC PLANT CONTROL TECHNIQUES**

## **Criteria to Evaluate the Selection of Aquatic Plant Control Techniques**

NH Department of Environmental Services

Water Division

### **Preliminary Investigations**

#### **I. Field Site Inspection**

- Verify genus and species of the plant.
- Determine if the plant is a native or exotic species per RSA 487:16, II.
- Map extent of the plant infestation (area, water depth, height of the plant, density of the population).
- Document any native plant abundances and community structure around and dispersed within the exotic/nuisance plant population.

#### **II. Office/Laboratory Research of Waterbody Characteristics**

- Contact the appropriate agencies to determine the presence of rare or endangered species in the waterbody or its prime wetlands.
- Determine the basic relevant limnological characteristics of the waterbody (size, bathymetry, flushing rate, nutrient levels, trophic status, and type and extent of adjacent wetlands).
- Determine the potential impacts to downstream waterbodies based on limnological characteristics (water chemistry, quantity, quality).

### **Overall Control Options**

For any given waterbody that has an infestation of exotic plants, one of three options will be selected, based on the status of the infestation, the available management options, and the technical knowledge of the DES Limnologists who have conducted the field work and who are preparing this plan. The options are as follows:

- 1) **Eradication:** Herbicide application targeted at exotic aquatic plant to be eradicated, to either eradicate the plant or to reduce overall biomass to a point where alternative non-chemical strategies may be used. This action will be followed by thorough annual monitoring for regrowth and the use of non-chemical actions to achieve the eradication.
- 2) **Containment:** The aim of this approach is to limit the size and extent of the existing infestation. An herbicide application may be used to reduce specified areas down to a percent cover of the exotic species so that it can be maintain or contained with alternative management strategies, including Restricted Use Areas, benthic barriers, and others. Subsequent herbicide applications may be necessary if the target species shows exponential growth and further spread.
- 3) **No action.** If the infestation is too large, spreading too quickly, and past management strategies have proven ineffective at controlling the target exotic aquatic plant, DES, in consultation with others, may elect to recommend 'no action' at a particular site. All



efforts will instead be made towards containment of the target species to that specific waterbody, so that downstream migration of the plant can be prevented.

If eradication or control is the recommended option to pursue, the following series of control techniques may be employed. The most appropriate technique based on the determinations of the preliminary investigation will be selected.

Guidelines and requirements of each control practice are detailed below each alternative.

**A. Hand-Pulling**

- Can be used for exotic or native species.
- Can be used if infestation is in a small localized area (sparsely populated patch of up to 5' X 5', single stems, or dense small patch up to 2' X 2').
- Can be used if plant density is low, or if target plant is scattered and not dense.
- Can be used if the plant could effectively be managed or eradicated by hand-pulling a few scattered plants.
- Use must be in compliance with the Wetlands Bureau rules.

**B. Mechanically Harvest or Hydro-Rake**

- Can not be used on plants which reproduce vegetatively by fragmentation (e.g., milfoil, fanwort, etc.) unless containment can be ensured.
- Can be used only if the waterbody is accessible to machinery.
- Can be used if there is a disposal location available for harvested plant materials.
- Can be used if plant depth is conducive to harvesting capabilities (~ <7 ft. for mower, ~ <12 ft. for hydro-rake).
- Funds are available for repeated harvesting activities in that season.
- A navigation channel is required through dense plant growth.

**C. Chemical Treatment**

- Can be used if application of chemical is conducted in areas where alternative control techniques are not optimum due to depth, current, use, or type of plant.
- Can be used for treatment of exotic plants where fragmentation is a high concern.
- Can be used where species specific treatment is necessary due to the need to manage other plants (rare or endangered that will not be impacted by chemical treatment).
- Can be used if other methods used as first choices in the past have not been effective.
- A licensed applicator should be contacted to inspect the site and make recommendations about the effectiveness of chemical treatment as compared with other treatments.

**D. Restricted Use Areas (per RSA 487:17, II (d))**

- Can be used for exotic species only.
- Can be established in an area that effectively restricts use to a small cove, bay, or other such area where navigation, fishing, and other activities may cause fragmentation to occur.
- Can not be used when there are several “patches” of an infestation of exotic aquatic plants throughout a waterbody.
- Can be used as a temporary means of control.

**E. Bottom Barrier**

- Can be used for exotic or native species.
- Can be used in small areas, preferably less than 10,000 sq. ft.
- Can be used in an area where the current is not likely to cause the displacement of the barrier.
- Can be used early in the season before the plant reaches the surface of the water.
- Can be used in an area to compress plants to allow for clear passage of boat traffic.
- Can be used in an area to compress plants to allow for a clear swimming area.

**F. Drawdown**

- Can be used if the target plant(s) are susceptible to drawdown control.
- Can be used in an area where bathymetry of the waterbody would be conducive to an adequate level of drawdown to control plant growth, but where extensive deep habits exist for the maintenance of aquatic life such as fish and amphibians.
- Can be used where plants are growing exclusively in shallow waters where a drawdown would leave this area “in the dry” for a suitable period of time (over winter months) to control plant growth.
- Can be used in winter months to avoid encroachment of terrestrial plants into the aquatic system.
- Can be used if it will not significantly impact adjacent or downstream wetland habitats.
- Can be used if spring recharge is sufficient to refill the lake in the spring.
- Can be used in an area where shallow wells would not be significantly impacted.
- Reference RSA211:11 with regards to drawdown statutes.

**G. Dredge**

- Can be used in conjunction with a scheduled drawdown.
- Can be used if a drawdown is not scheduled, though a hydraulic pumping dredge should be used.
- Can only be used as a last alternative due to the detrimental impacts to environmental and aesthetic values of the waterbody.

## **H. Biological Control**

- Grass carp cannot be used.
- Exotic controls, such as insects, cannot be introduced to control a nuisance plant.
- Research should be conducted on a potential biological control prior to use to determine the extent of host specificity.

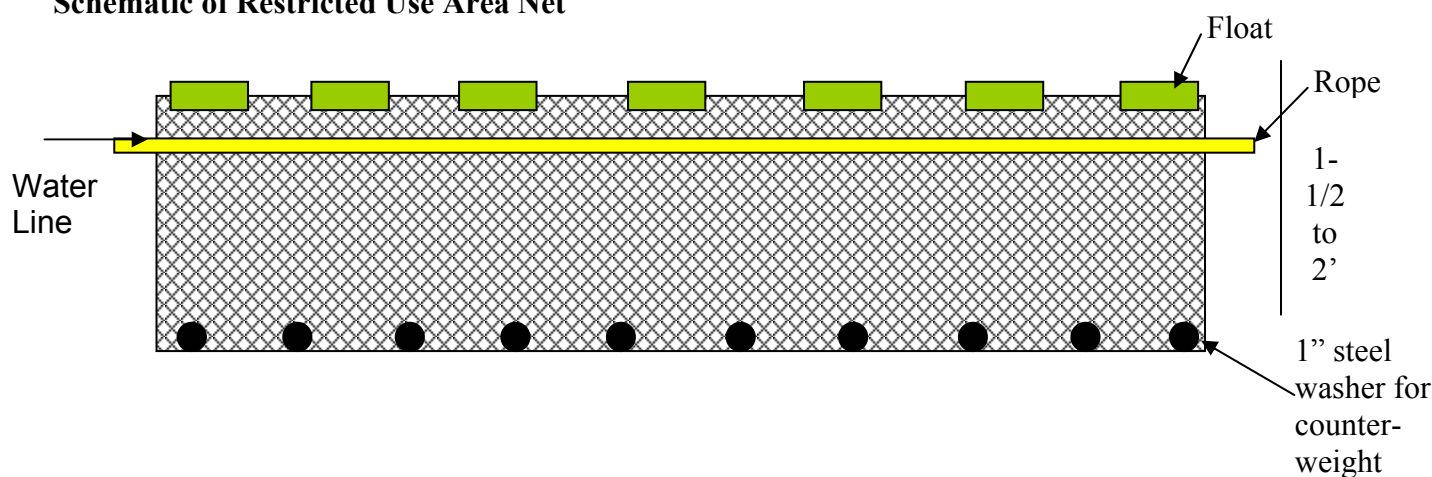
## **APPENDIX B**

### **SUMMARY OF CONTROL PRACTICES USED IN THE STATE OF NEW HAMPSHIRE FOR EXOTIC AQUATIC PLANTS**

### **Restricted Use Areas:**

Restricted Use Areas (RUAs) are a regular control option for lakes with small, contained infestations of exotic plants, limited to small patches or embayments. This is often the case in waterbodies with newly-discovered infestations. RUAs restrict access to all recreational activities in a delineated area to minimize plant fragmentation and thereby reduce the spread of milfoil. As an additional method of protection from fragment migration, RUAs are encircled with a shallow net that is suspended vertically in the water column. The net is approximately 1.5-2.0 feet in height. The top of the net is set to extend four inches above the surface of the water, while the remainder is positioned below the surface of the water (see figure below). This configuration prevents the movement of fragments from infested areas to uninfested areas. Due to the size and nature of net construction, there is no impediment to fish migratory patterns or spawning activities.

### **Schematic of Restricted Use Area Net**



### **Hand-pulling:**

When infestations of exotic aquatic plants begin as single scattered stems or small patches, DES biologists SCUBA dive to hand-pull the plants (and DES can train other certified divers to also perform this management practice). Guidelines for determining feasibility and effective for hand-removal are site specific, but generally sparsely populated patches of up to 5' X 5', single stems, or dense small patch up to 2' X 2' are reasonable.

The whole plant including the roots should be removed in this process, while leaving the beneficial native species intact. This technique works best in softer sediments, with shallow rooted species and for smaller, scattered infestation areas. When hand pulling nuisance species, the entire root system and all fragments of the plants must be collected since small root or stem fragments could result in additional growth of the species. The process must be repeated often to control re-growth of the exotic plants. For a new infestation, hand-pulling activities are typically conducted several times during the first season, with follow-up inspections for the next 2-5 years or until no re-growth is observed. This control practice has proven successful in many waterbodies.

### **Mechanical Harvesting**

The process of mechanical harvesting is conducted by using machines which cut and collect aquatic plants. These machines can cut the plants up to twelve feet below the water

surface. The weeds are cut and then collected by the harvester or other separate conveyer-belt driven device where they are stored in the harvester or barge, and then transferred to an upland site.

The advantages of this type of weed control are that cutting and harvesting immediately opens an area such as boat lanes, and it removes the upper portion of the plants. Due to the size of the equipment, mechanical harvesting is limited to water areas of sufficient size and depth. It is important to remember that mechanical harvesting can leave plant fragments in the water, which if not collected, may spread the plant to new areas. Additionally harvesters may impact fish and insect populations in the area by removing them in harvested material. Cutting plant stems too close to the bottom can result in re-suspension of bottom sediments and nutrients. This management option is only recommended when nearly the entire waterbody is infested, and harvesting is needed to open navigation channels through the infested areas.

### **Benthic Barriers:**

When a small infestation of exotic aquatic plants occurs in clusters of growth (generally areas  $>5 \text{ ft}^2$ ), as opposed to scattered stems, a permeable fiberglass screen can be placed over the area of infested lake sediments. The permeable fabric screening allows for gas release from the sediments while effectively blocking sunlight and compressing the plants into the sediment, inhibiting photosynthesis and eventually killing the plant. Occasionally, in some lakes, gas release from the sediments or boating activity cause the uplifting of screening. Benthic barriers can effectively control small infestations of less than approximately 10,000 square feet.

Benthic barriers have two basic applications. These practices are used to cover pioneering infestations and prevent the spread of the plant. Bottom barriers are installed across small portions of lake bottoms infested with invasive aquatic plants. The disadvantage of benthic barriers is their non-selectivity and limitation of cover to less than 10,000 square feet. Additionally, these physical barriers prevent the growth of all vegetation, which is a necessary component of fish and wildlife habitat.

Bottom barriers are attached to the bottom of a water body by re-bar attached to the edges and across the middle of the material. Bottom barriers are transported to the shoreline adjacent to where installation is to occur. They are then cut to fit the treatment site and rolled onto a length of pipe. Divers carry the roll into the water at the start of the treatment site and secure one edge of the material to the lake bottom. The divers then roll out the remainder of the material and continue to secure it to the bottom sediments. This process is repeated until the plants in the treatment are covered.

Bottom barriers are generally considered for small localized areas rather than lakewide application. Bottom barriers provide 100% control of this weed in areas where they are installed. They also provide long-term control. An ongoing maintenance operation is required to inspect the bottom barrier and clear the mats of sediment buildup.

Benthic barriers are not recommended for application in river systems, as flow can easily uplift the barrier.

### **Targeted Application of Herbicides:**

The use of chemicals, such as herbicides, for the control of noxious and nuisance plant species represents one of the most widely known and effective management options available. Herbicide control of invasive aquatic plants is often the first step in a long-term integrated control program. In the last 15 to 20 years the use and review of herbicides has changed significantly in order to accommodate safety, health, and environmental concerns. Currently no herbicide product can be labeled for aquatic use if it has more than a one in a million chance of causing significant harmful effects to human health, wildlife, or the environment. Because of this, the number of effective and U.S. Environmental Protection Agency (EPA) approved herbicides for aquatic weeds are limited. In most cases the cost and time of testing and registration, rather than environmental issues, limits the number of potentially effective compounds.

All herbicide applications in New Hampshire are performed under permits issued by the New Hampshire Department of Agriculture, Division of Markets and Food, Bureau of Pesticide Control.

Two herbicides have been used in New Hampshire for the control of milfoil. Diquat (trade name Reward), the most often-used herbicide, is a contact herbicide that can generally provide one season of control for milfoil. Because this herbicide does not target the root systems, the plants eventually re-grow from established roots.

The second herbicide, 2, 4-D (trade name Navigate or Aqua Kleen), is a systemic herbicide. It is absorbed into the sediments and taken up through the root system, killing both the roots and the plant biomass above the sediments. Label restrictions for aquatic application currently limit its use in New Hampshire to waterbodies with no water intakes, and with no wells adjacent to the shoreline.

The aquatic herbicide SONAR has been used in New Hampshire to control growths of fanwort. The chemical acts by limiting photosynthesis when chlorophyll-a is affected by the active ingredient of the herbicide.

### **Extended Drawdown**

Water drawdown is used for control of some species of aquatic macrophytes. Drawdown requires some type of mechanism to lower water levels, such as dams or water control structures and use is thus limited. It is most effective when the drawdown depth exceeds the depth or invasion level of the target plant species.

In northern areas, drawdown will result in plant and root freezing during the winter for an added degree of control. Drawdown is typically inexpensive and has intermediate effects (2 or more years). However, drawdown can have other environmental effects and interfere with other functions of the water body (e.g. drinking water, recreation, or aesthetics). Drawdown can result

in the rapid spread of highly opportunistic annual weed species, which in most cases is the plant that is targeted for control.

Drawdowns have been used in the past for plant control. In theory, the drying of the plants in the summer, or the freezing of the plants in the winter, will eliminate or limit plant growth. However, milfoil often forms a more succulent terrestrial form during drawdown conditions and the succulent form of the plant can remain viable for long periods of time without submergence, making the practice ineffective. This strategy can be used for control of some native plant species.

### **Dredging**

Dredging is a means of physical removal of aquatic plants from the bottom sediments using a floating or land-based dredge. Dredging can create a variety of depth gradients creating multiple plant environments allowing for greater diversity in lakes plant, fish, and wildlife communities. However due to the cost, potential environmental effects, and the problem of sediment disposal, dredging is rarely used for control of aquatic vegetation alone.

Dredging can take place in to fashion, including drawdown followed by mechanical dredging using an excavator, or using a diver-operated suction dredge while the water level remains up.

### **Biological Control**

There are no approved biological controls for submersed exotic aquatic plant at this time in New Hampshire.



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